

**RÉSEAU ÉLECTRIQUE MÉTROPOLITAIN
(REM) PROJECT**

MONTREAL, QUEBEC

**PRELIMINARY DESIGN & COST ESTIMATE
GAP ANALYSIS**

FINAL REPORT

June 23, 2017

Hanscom

RÉSEAU ÉLECTRIQUE MÉTROPOLITAIN (REM)
PROJECT

MONTREAL, QUEBEC

**PRELIMINARY DESIGN & COST ESTIMATE GAP
ANALYSIS**

FINAL REPORT

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June 23, 2017

PROJECT NUMBER: Ott-5337

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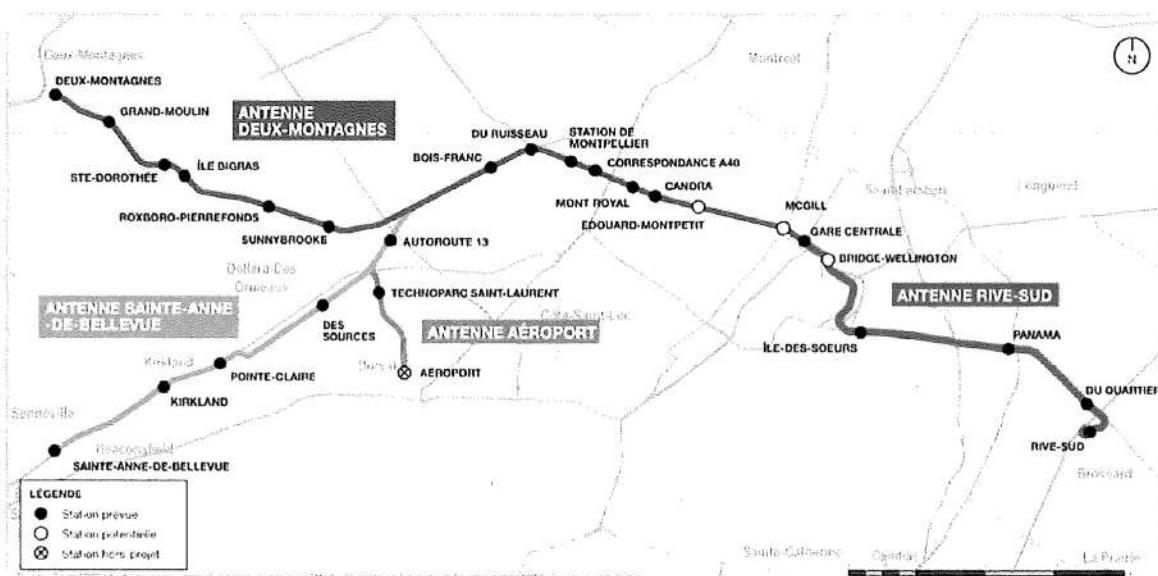
- A – Detailed Cost Estimate Analysis
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1.0 Preface Project Description

1.1 Overview of the project

The Réseau Électrique Métropolitain (REM) is 67km rapid transit system for the Greater Montreal area that would link several suburbs with Downtown Montreal via the Central Station. The REM includes 4 segments or branches namely: Deux-Montagnes (29.8 km), Rive-Sud (16.1 km), Sainte-Anne-de-Bellevue (16.5 km) and Montreal Airport (4.6 km). There will be a total of 27 stations (6 underground, 7 elevated and 14 surface) with Wi-Fi connection on the entire network. The system will be electric and fully automated. Traction power will be supplied using overhead catenary system. The stations will include an approximate 80m-long platforms, elevators, escalators, platform screen doors and will be integrated with existing transit networks and feeder buses. Park-and-ride facilities and bus terminals will be provided in some stations.

1.1.1 Project Network Map:



1.2 Deux-Montagnes Segment

1.2.1 Project Scope

- Implementation of approximately 32 km of new double track of which 5 km is in the interior Mont-Royal tunnel. The existing tracks and facilities will be replaced
- Conversion of existing 11 train stations along the REM including redevelopment of bus terminus, Park-and-ride parking stations, loading area, access roads for pedestrian and cyclist as well as other site development

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1.0 Preface Project Description

1.2 Deux-Montagnes Segment (Cont.)

1.2.1 Project Scope (Cont.)

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PRELIMINARY DESIGN & COST ESTIMATE GAP ANALYSIS

Hanscomb

1.0 Preface Project Description

1.2 Deux-Montagnes Segment (Cont.)

1.2.2 Stations (14)

- McGill
 - Underground station, platform type: no info available
- Edouart-Montpetit
 - Underground station, platform type: no info available
- Canora
 - Surface station, lateral platform
 - Bike stalls (100), Temp. Parking stalls (7)
- Mont-Royal
 - Surface station, lateral platform
 - Bike stalls (60), Temp. Parking stalls (8)
- Correspondance A40
 - Surface station, Central platform
 - Bike stalls (20), Temp. Parking stalls (6)
- Montpellier
 - Surface station, lateral platform
 - Bike stalls (6), Temp. Parking stalls (9)
- Du Ruisseau
 - Surface station, lateral platform
 - Bike stalls (45), Temp. Parking stalls (10), Park-and Ride (1060)
- Bois-Franc
 - Surface station, lateral platform
 - Bike stalls (80), Temp. Parking stalls (14), Park-and Ride (740)
- Sunny Brooke
 - Surface station, lateral platform
 - Bike stalls (30), Temp. Parking stalls (14), Park-and Ride (400)
- Roxboro-Pierrefonds
 - Elevated station, lateral platform
 - Bike stalls (50), Temp. Parking stalls (14), Park-and Ride (1040)
- Île-Bigras
 - Surface station, lateral platform
 - Bike stalls (20), Temp. Parking stalls (2), Park-and Ride (45)
- Sainte-Dorothée
 - Surface station, lateral platform
 - Bike stalls (45), Temp. Parking stalls (8), Park-and Ride (975)

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1.0 Preface Project Description

1.2 Deux-Montagnes Segment (Cont.)

1.2.2 Stations (14) (Cont.)

- Grand-Moulin
 - Surface station, lateral platform
 - Bike stalls (44), Temp. Parking stalls (6), Park-and Ride (230)
 - Deux-Montagnes
 - Surface station, lateral platform
 - Bike stalls (10), Temp. Parking stalls (16), Park-and Ride (1160)

1.3 Rive-Sud Segment

1.3.1 Scope of Work

- The Segment Rive-Sud is divided into 3 sections:

Within the City of Montreal

- • • • • • • • • •

1.0 Preface Project Description

1.3 Rive-Sud Segment

1.3.1 Scope of Work (Cont.)

Within the New Saint Lawrence Bridge

- 2

Along Autoroute 10 on the Rive-Sud

- 1

1.0 Preface Project Description

1.3 Rive-Sud Segment

1.3.1 Scope of Work (Cont.)

- [REDACTED]
- [REDACTED]

1.3.2 Stations (6)

- Gare Centrale
 - Underground station, Central platform
- Bassin Peel
 - Underground station, platform type: no info available
- Île-des-Soeurs
 - Surface station, lateral platform
 - Bike stalls (100), Temp. Parking stalls (38), Park and ride (700)
- Panama
 - Surface station, lateral platform
 - Bike stalls (200), Temp. Parking stalls (7)
- Du Quartier
 - Surface station, Central platform
 - Bike stalls (74), Temp. Parking stalls (6)
- Rive Sud
 - Elevated station, lateral platform
 - Bike stalls (50), Temp. Parking stalls (26), Park and ride (3000)

1.4 Sainte-Anne-de-Bellevue Segment

1.4.1 Scope of Work

- [REDACTED]

1.0 Preface Project Description

1.4 Sainte-Anne-de-Bellevue Segment

1.4.1 Scope of Work (Cont.)

- Connecting to the existing technical urban networks as required

1.4.2 Stations (5)

- Autoroute 13
 - Elevated station, lateral platform
 - Bike stalls (20), Temp. Parking stalls (6), Park-and Ride (500)
- Des Sources
 - Elevated station, lateral platform
 - Bike stalls (20), Temp. Parking stalls (6), Park-and Ride (500)
- Pointe-Claire
 - Elevated station, lateral platform
 - Bike stalls (50), Temp. Parking stalls (14), Park-and Ride (700)
- Kirkland
 - Elevated station, lateral platform
 - Bike stalls (25), Temp. Parking stalls (6), Park-and Ride (500)
- Sainte-Anne-Bellevue
 - Elevated station, lateral platform
 - Bike stalls (20), Temp. Parking stalls (26), Park-and Ride (200)

1.5 Aéroport Segment

1.5.1 Scope of Work

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1.0 Preface Project Description

1.5 Aéroport Segment

1.5.1 Scope of Work (Cont.)

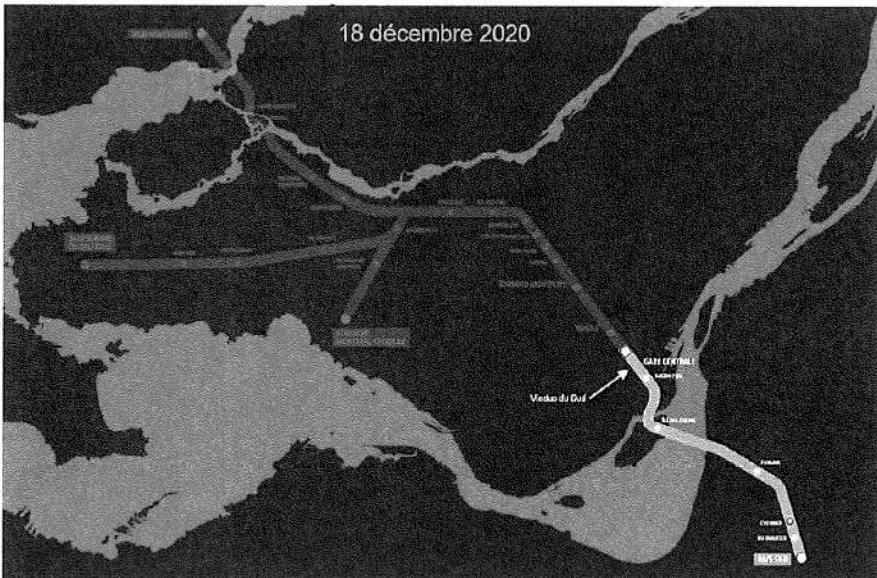


1.5.2 Stations (2)

- Technoparc Saint-Laurent
 - Underground station, lateral platform
 - Bike stalls (20), Temp. Parking stalls (6)
- Aéroport
 - Underground station, Central platform – by others
 - Park and ride – by others
 -

1.6 Project Phasing

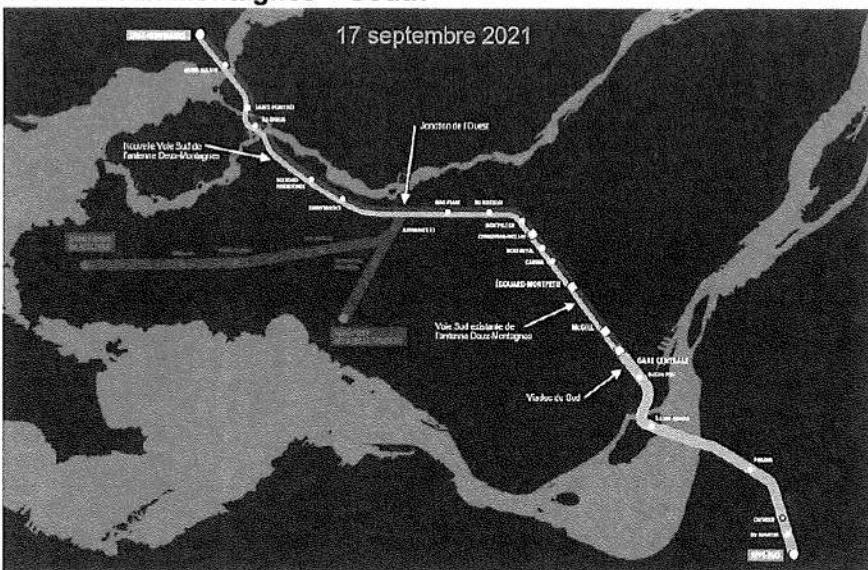
1.6.1 Rive-Sud



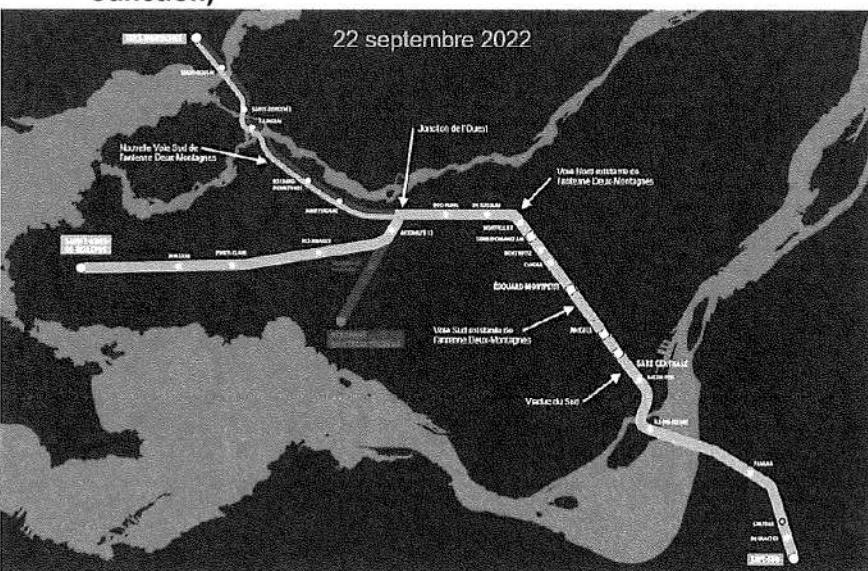
1.0 Preface Project Description

1.6 Project Phasing (Cont.)

1.6.2 Deux-Montagnes – South



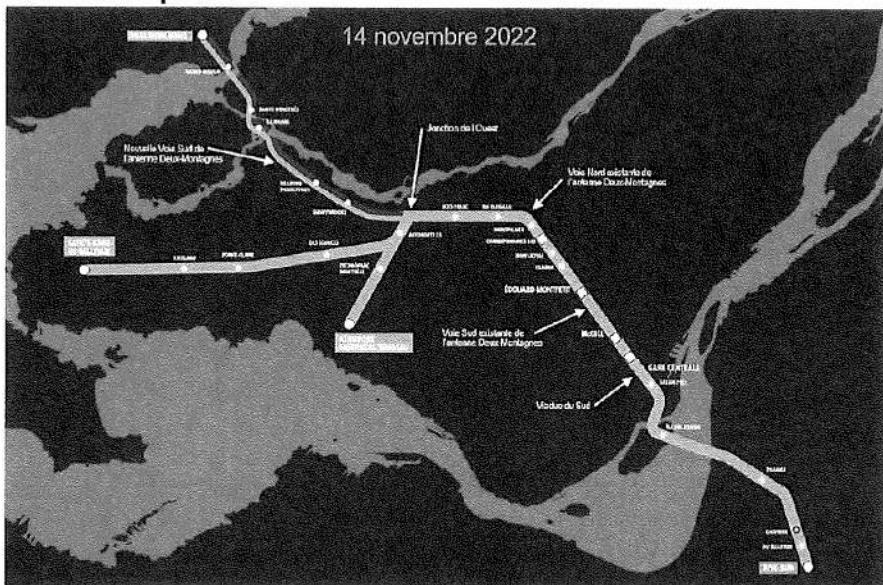
1.6.3 Sainte-Anne-de-Bellevue and Deux-Montagnes North (Gare Central to West Junction)



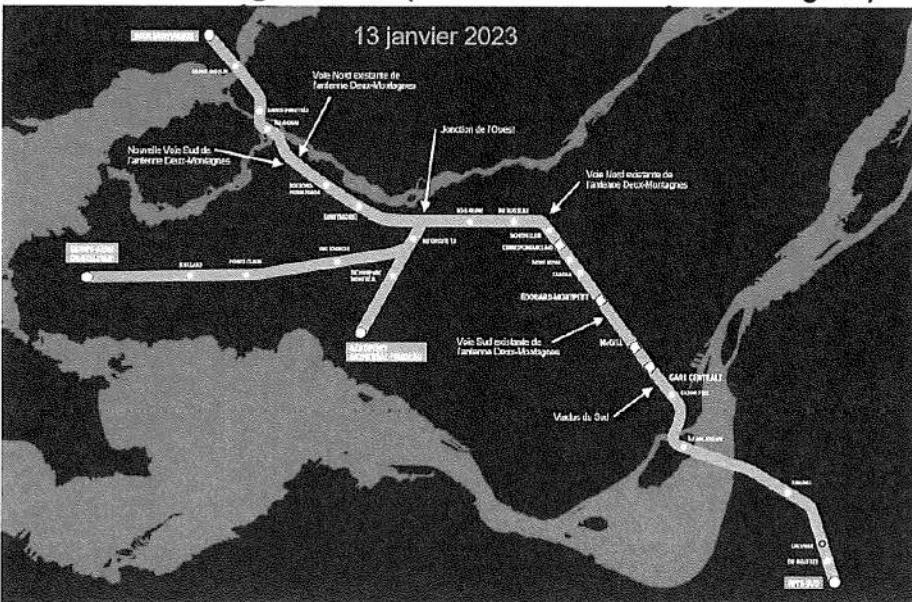
1.0 Preface Project Description

1.6 Project Phasing (Cont.)

1.6.4 Aeroport



1.6.5 Deux-Montagnes North (West Junction to Deux-Montagnes)



1.0 Preface Project Description

1.6 Project Phasing (Cont.)

Below is the latest contractual dates and project schedule as per Schedule 2 Rev BC:

Activity/Phase	Contractual Dates
[REDACTED]	

2.0 Hanscomb Roles & Responsibilities

2.1 Hanscomb Scope:

As per the Services Request form, Hanscomb's scope is as follows:

To complete an independent due diligence review and assessment of the Project's existing indicative design and cost estimates provided by CDPQ Infra and its advisors. The design and cost estimates due diligence review will be for the full lifecycle of the Project and include:

- Capital costs, civil works,
- Operations, maintenance, lifecycle/rehabilitation;
- Utilities, displacement,
- Site remediation/environmental contamination remediation
- Electrical works
- Supply of rolling stock,
- Control systems,
- SPV and development/administrative costs;
- Contingencies, and
- Project risks

To comment on the reasonableness and level of accuracy, assumptions, potential risks and explain any gaps in the design and cost estimates. The gap analysis will identify and recommend areas for further analysis and include a description and prioritization of next steps and activities required to fill these gaps. Hanscomb will also provide an assessment of:

- Potential issues/oversights in the indicative design,
- Volatility/sensitivity of cost components over the lifecycle of the assets; and
- The alignment/reasonableness of the project schedule with the proposed design.

Hanscomb is not to re-create the cost estimate; rather is expected to complete a detailed due diligence review and analysis of the existing indicative design and cost estimates, comment on their reasonableness and level of accuracy, and explain why any gaps in the design and cost estimates.

Throughout the course of the analysis phase of this assignment, Hanscomb will also provide ad-hoc advice to PPP Canada on matters related to design, engineering and cost analysis as requested.

2.0 Hanscomb Roles & Responsibilities

2.2 Expected Deliverables:

1st Deliverable: April 26, 2017

- First Draft – Preliminary Draft Design and Costing Review Report

2nd Deliverable: May 3, 2017

- Second Draft – Penultimate Design and Costing Review Report

3rd Deliverable: May 10, 2017

- Final Draft – Final Design and Costing Review Report

Note: The final draft deliverable date was moved to accommodate a meeting with CDPQ on May 11, 2017 and include additional time to review new documentation received after the meeting.

If Requested:

- A presentation of the Design and Costing Review Report Highlighting key findings

Note:

2.3 Exclusions

Our current exclusions of our review of the costing work provided by CDPQ are as follows:

Any cost associated with necessary agreements between the government of Canada and its agencies and the province of Quebec and its agencies.

We have not allocated or determined any costs for any government agency to cover any of their individual staff time associated with this project.

2.3 Methodology:

Our current methodology is to review and access all Hard and Soft costs as provided by PPP Canada. Our approach is to determine if the various material schedules follow a logical path and that the proposed unit rates reflect the general descriptions of the intended work.

We are also reviewing how this information in the details of the material and cost schedules are incorporated into the project total cost summaries. In addition, review and determine the rational of the project risk allowances and project specific contingencies.

We are also reviewing how this information in the details of the material and cost schedules are incorporated into the project total cost summaries. In addition, review and determine the rational of the project risk allowances and project specific contingencies.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

The goal within the first deliverable is to develop a total project cost summary that can be followed for the duration of our assignment on this project. This will enable Hanscomb and the consultants to ensure that the project has complete cost coverage of all aspects of the project including specific contingencies to cover the projects current and future risks.

The project will continue to advance in engineering design over the next eight months. We have anticipated that some of the proposed work items may not advance to the point where the consultant team has provided their supporting cost details. We believe that the best approach is to identify any of these areas and work with the consultant team to determine an appropriated amount of funds to cover the specific areas of concern. As the project information improves these assessments will be updated and the cost allocations will be revisited and the costs adjusted to reflect the newly developed information.

2.3.1 Project Cost Planning & Control Services Scope of Work Outline

Introduction

The key objectives of capital cost planning and control for any construction project are:

- to keep expenditures within the amount allocated for each of the various elements or segments of the project
- to achieve the best value for each dollar spent
- to achieve a balanced expenditure between the various elements or segments of the project.

In order to achieve these objectives a systematic form of cost control must be established. Effective cost planning and control systems are integrated into and operate within the total project management structure. Any cost planning and control system, for whatever purpose, embodies the following principles:

- there must be a frame of reference containing a realistic first estimate of the project and a plan of how this will be spent
- there must be a control mechanism that allows feedback or checking of the original cost plan as the project proceeds
- there must be a clearly defined procedure for taking remedial action as the project proceeds.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

The Cost Planning & Control Process

Participating as active members of the design team, Hanscomb's cost planners will begin by establishing a "cost plan" for the project which will be subdivided into elements or functional components, using the elemental cost estimating format prepared by the Canadian Institute of Quantity Surveyors (C.I.Q.S.). While these are 'elements' only loosely related to the traditional trade based estimating format used generally within the construction industry, there are distinct advantages in having this form of breakdown during the design stage. The subdivisions used in elemental estimates are immediately recognizable as design and functional components of the structure. Furthermore, there is a direct relationship between estimates of similar or even different structures, regardless of design and specification approach, which permits meaningful cost comparisons and analysis.

Once approved by the owner, the cost plan will set out the total cost limits for the project and will be subdivided into meaningful sections, each with its own cost and outline specifications stated. The cost plan will provide the frame of reference required as the first principle of an effective cost control system.

As the design proceeds, construction cost estimates will be prepared/reviewed at each milestone. These estimates will be based on the latest available design information completed to the highest level of detail commensurate with the submission documents for each stage. When complete, estimates will be reconciled with the Owner's approved budget. Should cost problems be identified, cost reduction strategies will be proposed for the Owner's approval. In this manner, the owner and design team will address cost problems in the most effective manner - as they are identified. This continuous cost checking and remedial action (the second and third principles of effective cost control) will be an integral part of the project design process.

Larger projects where the design and construction work is sequenced in a series of packages and stages, regular project Budget Status Reporting becomes a necessary control tool. Budget Status Reports are generated each month from a continuously updated database that includes such items as the original budget, owner approved changes, revised budget, latest estimate or contract value, contemplated changes, committed costs, contingency status, cashflows, etc. When combined with project schedules, the Budget Status Reports can also provide management timely comparisons of actual to forecast performance for each component and at every stage of the work. Each report can be customized to show varying levels of detail as required by various levels of management to monitor performance, identify problems and take the appropriate action.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Cost Planning Risk Management

In any estimate there is the potential for variation. In construction cost planning variations can be attributed to three primary sources:

- Incomplete, incorrect or misinterpreted design information;
- Cost escalation;
- Changes during construction.

The major objective of any construction cost plan is to arrive at a realistic and achievable 'bottom line', a total that an owner or manager can confidently carry into his project pro formas. The problem, then, is to address the risk of estimating variations within the cost plan, above the bottom line. The solution is to identify a contingency sum to absorb the costs of estimating variations without affecting the total.

The effective use of contingencies in construction cost planning requires a clear understanding of estimating risks in both a project specific and general construction market sense. The appropriate level of contingency is dependent on the amount of information available, knowledge of the design team's methods and philosophy, the timing of estimate preparation relative to the project design and construction schedule, and the anticipated complexity of the actual construction work.

Contingency assessment for a construction estimate is therefore divided into three distinct categories:

- Design and Pricing Contingency
- Escalation Contingency
- Post Contract (Change Orders) Contingency

The amount of total contingency carried will obviously vary dependent on project type and its point of progression through each stage of the design process, but the overall goal remains constant - to provide a realistic estimate of construction cost with a fixed and reliable bottom line.

Design and Pricing Contingency

The accuracy and detail of design information available to the construction cost planner will directly affect the precision of the completed estimate. It stands to reason that the better the information, the better the result. Unfortunately, it is almost always impractical to wait until the design is complete to undertake an estimate of its cost.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Months or even years of work may be required to bring a project to this stage only to find out that the whole venture is unaffordable. Cost Plans prepared at any stage during the design risk variation due to incomplete design information. The design and pricing contingency is applied to cushion the bottom line against these risks.

It is important to note that the design and pricing contingency is not intended to accommodate program (scope) changes. Changes to the owner's stated project requirements would necessarily result in corresponding adjustments to the budget.

Escalation Contingency

Within the construction industry, cost information is most readily available in current dollar terms. Contractors and suppliers can best provide cost information based on their current labour and material costs, volume of work, bidding conditions, type and size of project, expected construction duration, etc., all of which are known quantities today, but are subject to sporadic and sometimes unforeseeable changes in the future. It's no accident that contractors place time limitations on their bids.

It makes sense for construction cost planners to use the most accurate cost information available. In doing so, however, they produce estimates that reflect current market or bidding conditions. Where the design is incomplete or the actual construction start is to be delayed, there is the risk of cost increases due to escalation likely to occur between the time of estimate preparation and the commencement of work. The escalation contingency is applied to absorb any erosion in the buying power of the construction dollar during this interval.

Generally, it is assumed that cost escalation likely to occur during construction is included in the unit rates used to calculate the construction cost. For example, a painting contractor preparing a bid will take into account the timing of his work that may not commence until the project has been under construction for several months. He will make allowances for any expected labour and material cost increase during construction. However for megaprojects, or work undertaken over a protracted period of time, it may be necessary to consider other methods of estimating cost escalation during construction.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Post Contract (Change Order) Contingency

After the design is complete, the contract awarded and construction started, there will still be cost increases prior to the final accounting. Changes to the work will in all probability result in additional cost to the owner. Generally there are six reasons giving rise to changes in the work:

- Unforeseen conditions;
- Code changes applied retroactively;
- Minor co-ordination errors in drawings and specifications;
- Contractor proposed changes (usually credits);
- Owner requested changes;
- Errors and omissions

To the extent that changes result from unforeseen conditions, code changes or minor co-ordination difficulties, their correction will not usually materially affect the finished work, only the cost. The post contract contingency provides a fund to address these issues.

As previously discussed, owner requested changes that have the effect of changing the stated project requirements should be funded through amendment to the budget.

Contingency Amounts

Although the amount of contingency appropriate for a particular estimate will vary from project to project there are some general guidelines to follow. The contingency should reflect the type of project, its relative complexity, geographic location, current and anticipated market or bidding conditions, amount of design information available, printed or oral, the estimator's experience and familiarity with the design team etc. and represent a consigns of all parties to the project.

The Design and Pricing Contingency will be highest at the beginning of the design stage when the amount of information available to the cost planner is minimal. As the design proceeds, and decisions regarding the project's massing and materials are made the requirement for this contingency will reduce. At time of bid, when the documentation is 100% complete, there should be no further need of this contingency. For most new projects at the programming stage a design and pricing contingency of 10 - 20% should be adequate. The amount by which the contingency is reduced as the design advances must directly correspond to an increase in accuracy and detail of design information. Often, decisions to reduce the design and contingency too soon in the design process do not solve cost problems, just postpone them.

The Escalation Contingency will address anticipated changes in construction costs due to fluctuations in market conditions during the interval between cost plan preparation and project bid.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Forecasting construction cost escalation rates is a complex undertaking requiring careful assessment of a continually changing construction market. As these changes are, at best, difficult to predict, the escalation contingency should be monitored regularly and adjusted as required.

Finally, the determination of the Post Contingency (Change Order) Contingency must take into account the expected degree of difficulty to be encountered on site. Generally, renovation work presents more problems during construction than new work.

Contingency Guidelines for New Construction

	Pre-Schematic Design	Schematic Design	Design Development	Contract Documents	Tender & Award
Design	10 to 20%	7.5 to 10%	5 to 7.5%	1 to 5%	0 to 1%
Escalation	As required by prevailing market conditions				
Post Contract	Generally 1.5 to 3% for new infrastructure construction				

Careful and realistic contingency assessment is fundamental to the construction cost planning process. Properly used, contingencies afford owners and design professionals alike a measure of flexibility with a project budget to effectively manage project costs during design and construction.

Cost Planning & Control Activities

The following is a description of the construction cost planning and control activities that can be undertaken during the design and construction stages of any project to ensure the project budget is properly developed and respected. These activities apply to all work included within the mandate of the Project Control Specialist.

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Order of Magnitude Phase

- assist design team throughout the masterplanning/functional programming phase in capital and life-cycle cost evaluation of required function criteria.
- recommend appropriate design, escalation and post contract (construction stage) contingencies for construction cost estimating risk management
- prepare Draft Order of Magnitude Estimate based on documentation available at completion of masterplanning/functional programming stage
- reconcile with approved budget and assist design team in preparation of cost reduction strategies as required
- prepare final Order of Magnitude Estimate incorporating all approved changes
- **Note:** often, the completed and approved Masterplan/Functional Area Estimate is adopted by the owner as the official Project Budget and is used as the baseline for all future cost control on the project.

Schematic Design Phase

- assist design team throughout the schematic design phase in capital and life-cycle cost evaluation of massing schemes, layouts, alternative systems and components, etc.
- review and recommend appropriate design, escalation and post contract (construction stage) contingencies for ongoing construction cost estimating risk management

The outline below is our Typical Methodology. However, on this project, the successful proponent team would follow this methodology internally.

Design Development Phase

- assist design team throughout the design development phase in capital and life-cycle cost evaluation of building materials and components, etc.
- review and recommend appropriate design, escalation and post contract (construction stage) contingencies for ongoing construction cost estimating risk management
- prepare Draft Cost Plan based on documentation available at completion of design development stage
- reconcile with approved budget and assist design team in preparation of cost reduction strategies as required
- prepare final Cost Plan incorporating all approved changes

2.0 Hanscomb Roles & Responsibilities

2.3 Methodology (Cont.):

Construction and Tender Documents and Tendering Phase

- assist design team throughout the construction and tender documents and tendering phase in capital and life-cycle cost evaluation of building materials and components, etc.
- review and recommend appropriate design, escalation and post contract (construction stage) contingencies for ongoing construction cost estimating risk management
- prepare Cost Checks at 30%, 60% and 90% completion milestones (or as required to suit specific project requirements) based on documentation available at that point
- reconcile each Cost Check with approved budget and assist design team in preparation of cost reduction strategies as required
- prepare final version of each Cost Check incorporating all approved changes
- prepare Pre-Tender Estimate based on tender documents
- review addenda issued during tender period and adjust Pre-Tender Estimate as required
- assist design team in tender review and negotiations leading up to award of contract

Construction and Post Construction Phase

- review and evaluate contractor's application for progress payments and recommend amounts payable
- review and recommend appropriate, escalation and post contract (construction stage) contingencies for ongoing construction cost estimating risk management
- review, evaluate and assist in the negotiation and settlement of contractor's submissions for additional money in relation to change orders, field instructions, etc.
- prepare final account for settlement with contractor upon completion of construction work
- coordinate with other consultants and include costs for work items outside of the Architect's mandate in estimates and reports as deemed appropriate by the Owner and Architect

General

- continuously monitor and advise team of current and expected future construction market conditions which may affect construction costs
- prepare construction escalation forecasts and update quarterly for use with all estimates
- coordinate with, and provide information to, scheduling and value management participate in presentation of cost estimates, reconciliations, cost reduction strategies, etc. to Owner as required
- Follow the detailed milestone steps for the preparation of each deliverable as outlined within our preliminary work plan level of effort

**Page(s) 25 to 129
are withheld
pursuant to paragraph
13(1)(c), 20(1)(b), 20(1)(c) & 20(1)(d)
of the *Access to Information Act***

**La/les page(s) 25 à 129
Font l'objet d'une exception totale
conformément aux dispositions de paragraphe
13(1)(c), 20(1)(b), 20(1)(c) & 20(1)(d)
de la *loi sur l'accès à l'information***